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09/915,751	07/26/2001	Peter Geiger	5143-02501	7482

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EXAMINER

VERBRUGGE, KEVIN

ART UNIT	PAPER NUMBER
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2188

DATE MAILED: 06/23/2003

10

Please find below and/or attached an Office communication concerning this application or proceeding.

# Office Action Summary

Application No.

09/915,751

Applicant(s)

GEIGER ET AL.

Examiner

Kevin Verbrugge

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

## Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

## Status

- 1) ☒ Responsive to communication(s) filed on 08 April 2003.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

## Disposition of Claims

- 4) ☒ Claim(s) 1-134 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☒ Claim(s) 50-54 is/are allowed.
- 6) ☒ Claim(s) 1-9, 17-22, 25-28, 33-45, 55-76, 78-89, 93-117 and 125-134 is/are rejected.
- 7) ☒ Claim(s) 10-16, 23, 24, 29-32, 46-49, 77, 90-92 and 118-124 is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

## Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on \_\_\_\_\_ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

## Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

## Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 6.
- 4) ☐ Interview Summary (PTO-413) Paper No(s). \_\_\_\_\_
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other:

## **DETAILED ACTION**

### ***Response to Amendment***

This final Office action is in response to Amendment A, paper #7, filed 4/8/03, which amended claim 66. Claims 1-134 are pending. All objections and rejections not repeated below are withdrawn. The art rejections are repeated and made final because the arguments are not persuasive. Applicants' arguments are addressed following the repeated rejection.

### ***Specification***

The attempt to replace "09/239,658" with --09/239,659-- was unsuccessful because the final "9" was underlined and struck through. The Examiner has inserted --09/239,659-- and no further correction is necessary.

### ***Claim Rejections - 35 USC § 102***

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

The claims detailed below are rejected under 35 U.S.C. 102(b) as being anticipated by U.S. Patent 5,699,539 to Garber et al., hereinafter simply Garber.

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Regarding claims 1-4, 22, 33, 34, 38-42, 55-61, 93, 94, 98, 102, 129, and 131-134, Garber discloses a virtual memory management system and method using data compression.

In Fig. 2, he shows the claimed one or more processors as CPU 102.

He shows the claimed physical memory as primary memory 104.

The claimed system memory controller is inherent in his system since it is required to control primary memory 104.

He shows the claimed compressed memory management unit (CMMU) as virtual memory unit (VMU) 110.

Garber's VMU performs the claimed steps of receiving a system memory access including a system memory address, translating the system memory address into a first physical memory address, causing the decompression of compressed data at the first physical address, writing the decompressed data to a second physical address, and passing the second physical address to the system memory controller.

Furthermore, Garber's system fulfills the system memory access from the decompressed data at the second physical memory address and keeps least recently used data as compressed data in the physical memory and most recently and frequently used data as uncompressed data in the physical memory as claimed.

Regarding claims 36, 63, and 100, Garber's system includes program instructions for an operating system that is not aware of the increased effective size of the memory as claimed.

Regarding claims 73, 78, 79, and 125, Garber's device includes the claimed compression/decompression engine.

Regarding claim 67, Garber shows the claimed page translation table in Fig. 4 as his page table or page map.

Regarding claim 97, Garber teaches that his device monitors the actual compression ratio achieved at column 20, lines 40-49 and claim 4.

### ***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

The claims detailed below are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent 5,699,539 to Garber et al., hereinafter simply Garber.

Regarding claims 35, 37, 62, 64, 99, and 101, in Garber's device, the operating system is apparently unaware of the increased effective size of the memory. However, It would have been obvious to one of ordinary skill in the art at the time the invention

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was made to make the operating system aware of the increased effective size of part or all of the system memory to provide enhanced memory control to the operating system.

Regarding claims 5-9, 17-19, 25-28, 43-45, 65, 68-70, 74-76, 103, 126, and 127, Garber does not disclose a page translation cache, but It would have been obvious to one of ordinary skill in the art at the time the invention was made to include such a cache (also known as a translation lookaside buffer) since TLBs were well-known in the art at the time and improved operation speed by caching recently used page address translations.

Garber does not disclose the claimed scatter/gather DMA channels but his device operates equivalently by transferring and receiving data to and from the VMU as needed.

The steps of looking in the TLB for a translation, and if not found, of obtaining it from the page table and storing it in the TLB were well-known at the time of the invention and would obviously be implemented if a TLB were implemented.

Regarding claims 66 and 104, Garber's device includes the claimed compression/decompression engine.

Regarding claims 20, 21, 71, 72, and 105, TLBs were commonly fully-associative for design choice reasons, typically the flexibility in placing an entry in any slot and comparing all entries at once.

Regarding claims 80-89 and 106-117, the locations of the various elements are a matter of design choice, with certain advantages gained by placing certain elements in certain locations.

Regarding claim 95, Garber does not indicate that his page size is programmable, but he indicates that the page size is variable and is a matter of design choice and therefore It would have been obvious to one of ordinary skill in the art at the time the invention was made to make the page size programmable.

Regarding claim 96, Garber does not indicate that his maximum compression ratio is programmable, but It would have been obvious to one of ordinary skill in the art at the time the invention was made to make it programmable to affect various degrees of compression.

Regarding claim 128, Garber's device maintains the claimed lists as shown in Fig. 13 for example.

Regarding claim 130, Garber does not teach that his threshold ratio is programmable, but It would have been obvious to one of ordinary skill in the art at the time the invention was made to make it programmable to achieve a specific ratio. In Garber's device, the ratio is roughly 3:1, compressed pages to uncompressed pages.

### ***Response to Arguments***

#### 102 Arguments (pages 30-32)

Applicants argue that Garber's system "relies" on secondary memory (disk) to store compressed pages when insufficient primary memory is available in the compression heap in primary memory. The Examiner agrees. When necessary, Garber's device swaps compressed pages out to disk. But this is not always necessary, as indicated by Garber himself when he teaches that his device swaps "few, if any, pages out to secondary memory" (column 4, lines 2-3, emphasis added). He specifically mentions "if any" which is clear teaching that sometimes it is not necessary to swap any pages out to disk. It is clear that when the size of the virtual address space being used is sufficiently small (when the number of pages being used is sufficiently small), all of the desired pages will be able to fit in his primary memory, avoiding all swaps out to disk.

In any case, the claimed invention is anticipated by a device that swaps pages out to disk because the claims do not preclude swapping pages out to disk.

In a first interpretation of the claims, physical memory and system memory can include a disk. The broadest reasonable interpretation of physical memory includes a disk because a disk is a physical device. The broadest reasonable interpretation of system memory includes a disk because a disk is used by and is available to a system and is therefore a system device. If Applicants believe that their specification clearly teaches that physical memory and system memory cannot include a disk and they want



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this interpretation for the claims, then they must clearly state this and point out the passages of the specification which support it.

In a second interpretation of the claims, where physical memory and system memory cannot include a disk, the broadest reasonable interpretation of the claims still allows them to be anticipated by Garber because the claims do not preclude a device that uses a disk in conjunction with physical memory. The claims require compression and decompression of pages in physical memory which Garber's device performs. Nothing in the claims precludes the use of a disk in conjunction with the physical memory.

Applicants argue that their "claimed invention does not rely on secondary memory", but neither is their claimed invention distinguished from a device that sometimes does use secondary memory, because a device which comprises primary and secondary memory (Garber's) also comprises primary memory, as claimed by Applicants.

Applicants further argue that in their claimed memory system, "the effective size of system memory is increased by storing the least used pages in a compressed format in system memory" and they cite their specification at page 19, lines 9-11. But in the very next sentences in the specification, at page 19, lines 11-15, Applicants teach that "In addition, pages from the compressed cache 240, which are maintained in compressed format, can be moved to disk or network in such format for future data storage, retrieval, or transmission over LANs or WANs. Thus, a second order benefit is

achieved by storage of compressed pages in the I/O subsystem 300 instead of non-compressed pages" (emphasis added).

So not only do the claims not preclude use of a disk to store compressed pages, but the specification actually teaches the same.

103 Arguments (page 32)

Applicants challenged the Examiner's assertion that certain things were well-known at the time of the invention and demanded documented evidence to support the Examiner's assertion. In fact, the only thing that the Examiner asserted was well-known was the presence and use of translation lookaside buffers (TLBs) as page translation caches.

In an effort to support the Examiner's position that TLBs were well-known, the Examiner considered providing a reference but in fact the Applicants themselves have provided a reference on their latest 1449 which includes a TLB. Reference A5 (WO 97/23828) which was published well in advance of Applicants' filing date clearly shows a TLB in the cover figure which is Fig. 3. The reference extensively describes TLB operation at page 2, lines 24-33 and mentions the TLB in several other places. So Applicants' own submission is relied on as documented evidence that TLBs were well-known in the art at the time of the invention.

The other 103 rejections were not based on things that the Examiner asserted were well-known, but rather on things that would have been obvious to skilled artisans as minor modifications of Garber's device. If Applicants wish to challenge any of them

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specifically, then they need to be addressed individually with arguments why the Examiner's assertions are inappropriate.

***Allowable Subject Matter***

Claims 50-54 are allowed.

Claims 10-16, 23, 24, 29-32, 46-49, 77, 90-92, and 118-124 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

***Conclusion***

**THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of

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the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

The method claims are grouped and rejected with the apparatus claims because the steps of the method are met by the disclosure of the apparatus and methods of the reference(s) as discussed above.

Any inquiry concerning this or an earlier communication from the Examiner should be directed to Primary Examiner Kevin Verbrugge by phone at (703) 308-6663.

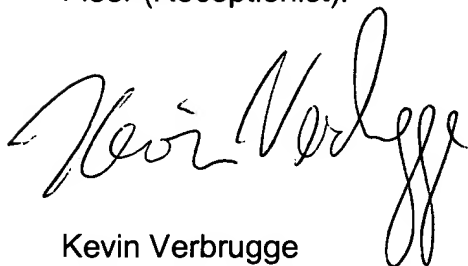
Any response to this action should be mailed to Commissioner for Patents, Washington, D.C. 20231 or faxed to

(703) 746-7238 After-final

(703) 746-7239 Official

(703) 746-7240 Non-Official/Draft

and labeled appropriately (After-final, Official, Non-Official/Draft). Hand-delivered responses should be brought to Crystal Park 2, 2121 Crystal Drive, Arlington, VA, 4th Floor (Receptionist).

A handwritten signature in black ink, appearing to read 'Kevin Verbrugge', is written over the printed name and title.

Kevin Verbrugge  
Primary Examiner  
6/23/03